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International Responses to the Emerging Threat of Antimicrobial Resistance

The problem of antimicrobial resistance (AMR) is not confined to a few countries but rather is a challenge that affects the entire world. The extent and pattern in which antimicrobials are utilised can, however, have a significant impact on the degree of urgency or severity of the condition. The problem has gradually but steadily extended to every single country in the globe, posing a threat to the safety of human, animal, and plant health as well as the security of food production. The consistent rise in the consumption of antibiotics in both the human and animal sectors raises serious concerns about a future in which not a single antibiotic will be available for the treatment of even the most prevalent bacterial diseases.

The drivers of AMR are present in human health, animal production, environment, and plant production sectors. Therefore, the problem requires joint and global efforts to address the challenge. In this pursuit, the first and foremost step is to measure the extent of the problem in different sectors. There is a coordinated effort underway to address this potential calamity including a wide range of international organisations. In response to the impending socioeconomic concerns of AMR, the World Health Organization (WHO) in its 68th World Health Assembly (WHA) adopted the Global Action Plan (GAP) on antimicrobial resistance, which was jointly developed by WHO, the Food and Agriculture Organization (FAO) and the World Organization of Animal Health (OIE).[1] This action plan emphasizes the importance of a sustainable "one health" strategy for cooperation between multiple worldwide sectors and actors, including human and veterinary medicine, agriculture, the environment, finance, and informed consumers.

The global action plan on antibiotic resistance specifies the following five strategic goals:[1]

(1) To improve AMR awareness understanding among the general population
(2) To utilize effective surveillance for generating evidence
(3) To minimise the disease and infection events
(4) To regulate the usage of antimicrobial agents in the human and animal sector
(5) To invest in research and development to counter antimicrobial resistance

For as long as practicable, the action plan aims to maintain access to effective medicines for treating and preventing infectious diseases, with the availability and accessibility of safe and quality-assured drugs which are used responsibly by all those who require their usage.

All 194 WHO Member States are urged by the World Health Assembly decision to align their National Action Plan on Antimicrobial Resistance (NAP) with GAP-AMR. The United Nations General Assembly's High-Level Meeting on AMR further reinforced the commitment of global leaders to address AMR.[2] Many countries have operationalised NAP-AMR; however, a few underdeveloped nations are in the midst of developing effective and fully functionalised NAP.[3]

These international bodies have operationalised surveillance and monitoring of AMR and Antimicrobial usage (AMU) at regional and integrating information at global. WHO started Global Antimicrobial Surveillance System (GLASS) in 2016 to collect official data on AMR and AMU.[4] As of May 2021, 109 countries are enrolled in this surveillance system and sharing data, however, there are limited countries contributing data on AMU.[5] Antibiotic usage in the major driver for AMR, therefore information on its extent of usage can provide valuable insight on its influence on the problem.

In another surveillance program started in 2005 by WHO as WHO-Global Salmonella Surveillance system which was later renamed as Global Foodborne Infections Network (GFN).[6] Surveillance was committed to enhancing the capacities of countries to detect respond and prevent foodborne and other enteric infections from farm to table. The network work with countries to build national capacities for integrated surveillance and promote collaboration among various sectors. The network has also developed manuals and protocols for detection of various pathogens, Antibiotic sensitivity testing (AST) protocol and molecular detection methods for implementation of surveillance system in and harmonised manner.[7]

WHO also established Advisory Group on Integrated Surveillance of Antimicrobial Resistance (AGISAR) to support and build national capacities on integrated surveillance of AMR & AMU.[8] In its 6th review meeting it was agreed to develop and standardise protocols with One Health approach. ESBL *E. coli* Tricycle Surveillance, a model of integrated surveillance of AMR with harmonizes protocol with single key indicator was started to assess the frequency of ESBL producing *E. coli* in human, food chain and the environment.[9]

Food and Agriculture Organization (FAO) which looks after agriculture and food sector is also active in surveillance of AMR and has developed FAO Assessment Tool for Laboratories and AMR Surveillance System (FAO-ATLASS).[10] For this they have developed platform, International FAO Antimicrobial Resistance Monitoring data (InFARM) for collection, analysis and reporting of AMR data from food and agriculture sector at national level, including AMU data in plants and crops.[11]

World Organization of animal health (OIE) has mandate to improve animal health, welfare and veterinary public health. The organisation has set standards related to AMR & AMU which are available in Terrestrial Animal Health code and Aquatic Health code.[12] The standards and protocols are aimed to harmonise national, AMR surveillance and monitoring program. On antibiotic usage OIE collect data from member countries on usage of OIE listed antimicrobials of veterinary importance and is regularly publishing report. OIE in its ongoing efforts is working on an AMU database project for the countries to have tailor made tool of their need, setup tool/ software to help countries in annual collection of data on AMU.

Accepting the importance of AMR across different sectors and to retain the effectiveness of antimicrobials in treating diseases, promote health of the people and food safety, the three international organisations in its resolution in 68th WHA stressed upon the collaborative and multisectoral 'One Health' approach to address the problem. As a consequence of this,

in May 2018 the three organisation signed a Memorandum of Understanding (MoU) as a Tripartite agreement for joint cooperation to address the issue of AMR.[13] The Tripartite also involved United Nation Environmental Program (UNEP) to integrate environment as well in their efforts to combat AMR. They have developed Tripartite workplan to be implemented in 10 pilot countries where impact of AMR is likely to be greatest. The workplan will help in implementing multisectoral National Action Plan (NAP) on AMR across the human, animal, plant, food and environment. The Tripartite agreement has also advocated for a common platform Tripartite Integrated Surveillance System (TISSA) where harmonised surveillance data from different sectors will come through their respective organisation and available at one point for analysis of trends and policies decisions.[14]

Whereas in 2019, due to the pandemic, the aggressive efforts employed to combat AMR were redirected to protect the world from the immediate threat. The lack of a solid public health system, which may contribute to the emergence of antibiotic resistance throughout healthcare institutions, nations, and the globe, was painfully obvious. In the year 2019, estimates for the number of deaths associated to bacterial AMR ranged between 3.62 million and 4.95 million.[15]

International leadership united with more comprehensive measures after fully comprehending the implications of AMR. The Global Leaders Group on Antimicrobial Resistance was created in January 2021 for the purpose of collaborating for long-term political action on AMR.[16] In collaboration with UNEP, a Tripartite Strategic Framework on AMR for the years 2022–2026 was prepared. The "Call to Action" for the UN General Assembly High-Level Dialogue 2021, which was endorsed by 35 non-state entities and signed by 113 Member States, included AMR as a key component.[17]

REFERENCES

1. Global Action Plan on Antimicrobial Resistance. Microbe Mag. 10, 354-355 (2015).
2. www.un.org/pga/71/event-latest/high-level-meeting-on-antimicrobial-resistance/, visited on August 22, 2022.
3. https://amrcountryprogress.org/#/map-view, visited on August 22, 2022.
4. World Health Organization. Global antimicrobial resistance surveillance system (GLASS): technical meeting on the early implementation phase. (2016).
5. https://www.who.int/publications/i/item/9789240027336, visited on August 22, 2022.
6. Arthur, R. R., LeDuc, J. W., Hughes J. M. Global Surveillance for Emerging Infectious Diseases. Tropical Infectious Diseases: Principles, Pathogens and Practice. 9. 105. (2011)
7. https://www.cdc.gov/ncezid/dfwed/pdfs/gfn.pdf, visited on August 22, 2022.
8. World Health Organization. Integrated surveillance of antimicrobial resistance in foodborne bacteria: application of a one health approach: guidance from the WHO Advisory Group on Integrated Surveillanec of Antimicrobial Resistance (AGISAR). (2017).
9. WHO. Global Tricycle Surveillance – ESBL *E. coli* - Integrated Global Surveillance on ESBL-Producing *E. coli* Using a "One Health" Approach: Implementation and Opportunities. (2021).
10. FAO. FAO Assessment Tool for Laboratories and AMR Surveillance Systems (ATLASS). Available online at: http://www.fao.org/antimicrobial-resistance/resources/tools/fao-atlass/en/ , visited on August 22, 2022.
11. https://www.fao.org/antimicrobial-resistance/resources/database/infarm/en/, visited on August 22, 2022.
12. https://www.woah.org/en/what-we-do/standards/codes-and-manuals/, visited on August 22, 2022.
13. FAO, OIE, WHO. MoU Regarding cooperation to combat health risks at the animal-human-ecosystems interface in the context of the "One Health" approach and including AMR. (2018)
14. WHO, FAO, WOAH, UNEP. The Tripartite Workplan on antimicrobial resistance. J Lang Relatsh. (2019)
15. Murray, C. J., Ikuta, K. S., Sharara, F., Swetschinski, L., Robles Aguilar, G., Gray, A., Han, C., Bisignano, C., Rao, P., Wool, E., Johnson, S. C., Browne, A. J., Chipeta, M. G., Fell, F., Hackett, S., Haines-Woodhouse, G., Kashef Hamadani, B. H., Kumaran, E. A. P., McManigal, B., Naghavi, M. Global burden of bacterial antimicrobial resistance in 2019: a systematic analysis. The Lancet, 399(10325), 629–655, (2022).
16. https://www.amrleaders.org/#tab=tab_1, visited on August 22, 2022.
17. WHO. WHO Strategic Priorities on Antimicrobial Resistance. (2022).

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